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(54) **MINIATURE PROJECTION DEVICE FOR EMITTING LASER BEAMS**

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G02B 7/00	(2006.01)
G02B 26/08	(2006.01)

(52) **U.S. Cl.**

CPC ***G02B 26/101*** (2013.01); ***H04N 9/3129*** (2013.01); ***H04N 9/3173*** (2013.01); *G02B 7/005* (2013.01); *G02B 26/0841* (2013.01)

(58) **Field of Classification Search**

CPC . H04N 9/3135; H04N 9/3161; G02B 6/3518; G02B 26/0833; G02B 6/3584; G02B 6/3656; G02B 21/14

See application file for complete search history.

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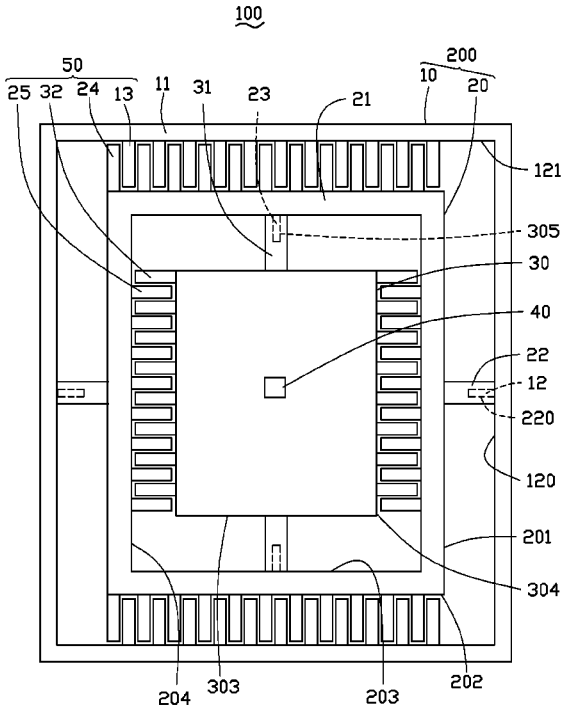
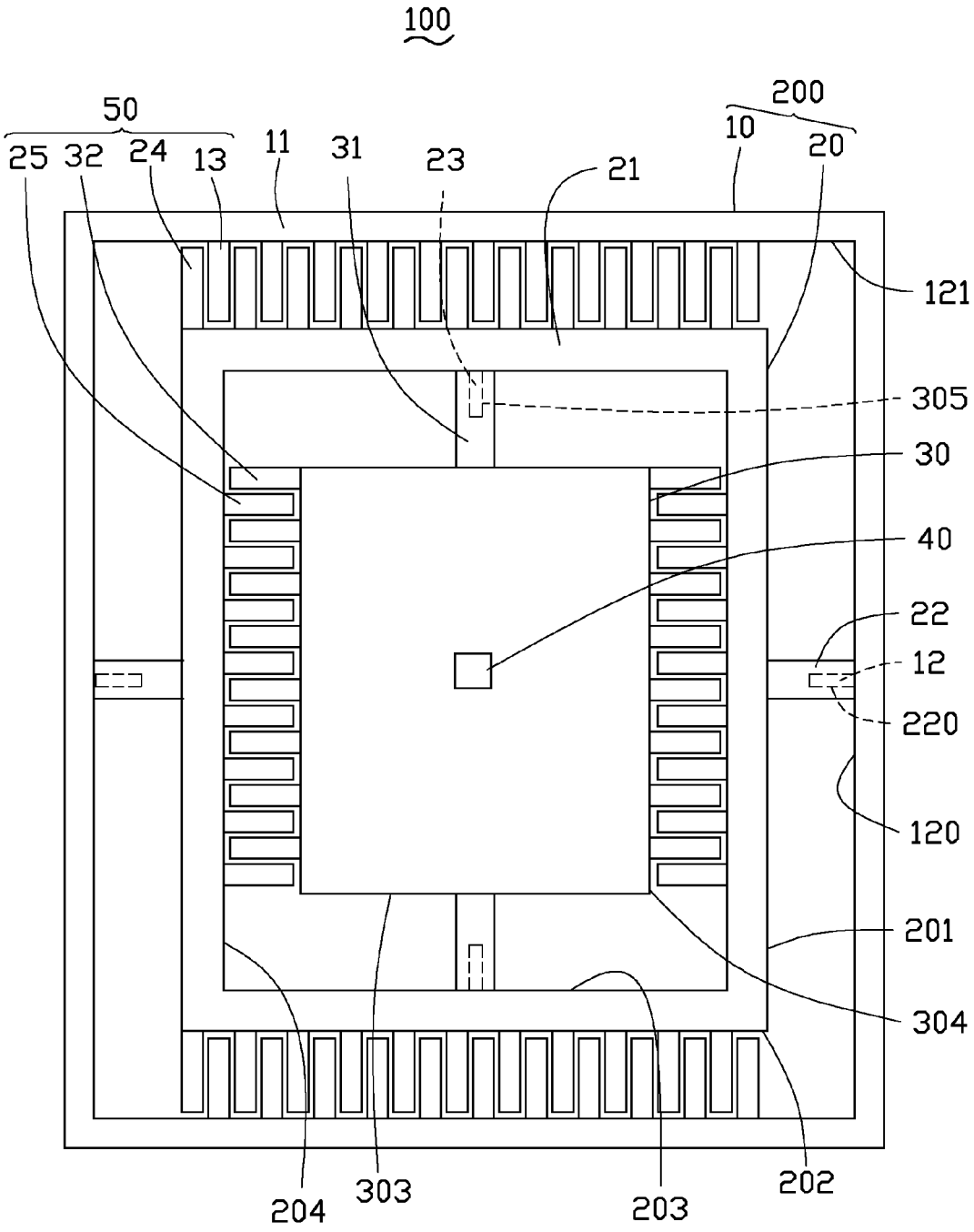
(57) **ABSTRACT**

A miniature projection device includes a rotatable bracket assembly, a rotating plate, a driving device, and a light source unit. The rotating plate is rotatably mounted to the rotatable bracket assembly. The driving device is configured to drive the rotatable bracket assembly to rotate in a first direction, and to drive the rotatable plate to rotate in a second direction. The first direction is substantially perpendicular to the second direction. The light source unit is mounted on the rotatable plate and is capable of rotating together with the rotating plate. The light source unit is configured to emit laser beams and to project the laser beams onto a screen.

12 Claims, 1 Drawing Sheet

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MINIATURE PROJECTION DEVICE FOR EMITTING LASER BEAMS

BACKGROUND

1. Technical Field

The present disclosure relates to projection devices, and particularly to a miniature projection device.

2. Description of Related Art

Laser projection devices are becoming more and more popular due to their having a larger color gamut, a higher brightness, a higher contrast ratio, and a better saturation. A MEMS mirror device mounted in the laser projection device is configured for reflecting laser beams emitted by a light source onto a screen. However, a size of the MEMS mirror device is very large, which is undesirable for miniaturizing the laser projection devices.

Therefore, it is desirable to provide a miniature projection device that can overcome the above-mentioned limitations.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the present disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the present disclosure.

The FIGURE is a schematic view of an embodiment of a miniature projection device.

DETAILED DESCRIPTION

The FIGURE shows a miniature projection device **100** configured to emit laser beams and to project the laser beams onto a screen (not shown). The miniature projection device **100** includes a rotatable bracket assembly **200**, a rotatable plate **30**, a light source unit **40**, and a driving device **50**. The rotatable bracket assembly **200** includes a first rotatable bracket **10** and a second rotatable bracket **20** rotatably received in the rotatable bracket **10**. The rotatable plate **30** is rotatably received in the second rotatable bracket **20**. The light source unit **40** is mounted on the rotatable plate **30** and is rotatable with the rotatable plate **30**. The driving device **50** is configured to drive the rotatable bracket assembly **200** and the rotatable plate **30** to rotate. In the embodiment, the driving device **50** includes a number of first electrodes **13**, a number of second electrodes **24**, a number of third electrodes **25**, and a number of fourth electrodes **32**.

The first rotatable bracket **10** is substantially rectangular and formed by four first connection poles **11**. The first rotatable bracket **10** includes two oppositely facing first inner side surfaces **120** and two oppositely facing second inner side surfaces **121**. The first inner side surfaces **120** are substantially perpendicular to the second inner side surfaces **121**. In the embodiment, the first rotatable bracket **10** includes two first rotation shafts **12**. Each first rotation shaft **12** is mounted to a central portion of a corresponding first inner side surface **120**. Each first rotation shaft **12** extends toward the second rotatable bracket **20**. The first rotation shafts **12** allow the second rotatable bracket **20** to rotate along a first direction. The first electrodes **13** are mounted on the two second inner side surfaces **121**.

The second rotatable bracket **20** is also substantially rectangular and formed by four second connection poles **21**. A size of the second rotatable bracket **20** is smaller than a size of the first rotatable bracket **10**. The second rotatable bracket **20** includes two first outer side surfaces **201** and two second outer side surfaces **202**. The two first outer side surfaces **201** are substantially parallel to each other, and each first outer side surface **201** faces a corresponding first inner side surface **120**. The two second outer side surfaces **202** are substantially parallel to each other, and each second outer side surface **202** faces a corresponding second inner side surface **121**.

In the embodiment, the second rotatable bracket **20** includes two first sleeve shafts **22**. Each first sleeve shaft **22** is mounted to a central portion of a corresponding first outer side surface **201** and extends toward and connects to a corresponding first inner side surface **120**. Each first sleeve shaft **22** defines a first mounting hole **220** for receiving the corresponding first rotation shaft **12**.

The second electrodes **24** are mounted on the two second outer side surfaces **202**. Each second electrode **24** is located between two first electrodes **13**, and each first electrode **13** is located between two neighboring second electrodes **24**.

The second rotatable bracket **20** includes two oppositely facing third inner side surfaces **203** and two oppositely facing fourth inner side surfaces **204**. In the embodiment, the second rotatable bracket **20** includes two second rotation shafts **23**. Each second rotation shaft **23** is mounted to a central portion of a corresponding third inner side surface **203**. Each second rotation shaft **23** extends toward the rotatable plate **30**. The second rotation shafts **23** allow the rotatable plate **30** to rotate along a second direction. Axes of the second rotation shafts **23** are substantially perpendicular to axes of the first rotation shafts **12**.

The third electrodes **25** are mounted on the two fourth inner side surfaces **204**.

The rotatable plate **30** is substantially rectangular. A size of the rotatable plate **30** is smaller than the size of the second rotatable bracket **20**. The rotatable plate **30** includes two third outer side surfaces **303** and two fourth outer side surfaces **304**. The two third outer side surfaces **303** are substantially parallel to each other, and each third outer side surface **303** faces a corresponding third inner side surface **203**. The two fourth outer side surfaces **304** are substantially parallel to each other, and each fourth outer side surface **304** faces a corresponding fourth inner side surface **204**.

In the embodiment, the rotatable plate **30** includes two second sleeve shafts **31**. Each second sleeve shaft **31** is mounted to a central portion of a corresponding third outer side surface **203** and extends toward and connects to a corresponding third inner side surface **203**. Each first sleeve shaft **22** defines a first mounting hole **220** for receiving the corresponding first rotation shaft **12**. Each second sleeve shaft **31** defines a second mounting hole **305** for receiving a corresponding second rotation shafts **23**.

The fourth electrodes **32** are mounted on the two fourth outer side surfaces **304**. Each fourth electrode **32** is located between two neighboring third electrodes **25**, and each third electrode **25** is located between two neighboring fourth electrodes **32**.

A size of the light source unit **40** is smaller than the size of the rotatable plate **30**. The light source unit **40** is located on the rotatable plate **30** and configured to emit laser beams onto the screen.

In use, first electrostatic forces generated by the first electrodes **13** and the second electrodes **24** drive the second rotatable bracket **20** to rotate relative to the first rotatable bracket **10** along the first direction. Second electrostatic forces generated by the third electrodes **25** and the fourth electrodes **32** drive the rotatable plate **30** to rotate in the second rotatable bracket **20** along the second direction. The second direction is substantially perpendicular to the first direction. As such, the rotatable plate **30** can be rotated in two directions in the first

rotatable bracket **10**. As the light source unit **40** is mounted on the rotatable plate **30**, a direction of emitted light can be changed according to the rotation of the rotatable plate **30**.

In other embodiments, shapes of the first rotatable bracket **10**, the second rotatable bracket **20**, and the rotatable plate **30** can be changed according to actual needs.

It will be understood that the above particular embodiments are shown and described by way of illustration only. The principles and the features of the present disclosure may be employed in various and numerous embodiment thereof without departing from the scope of the disclosure as claimed. The above-described embodiments illustrate the possible scope of the disclosure but do not restrict the scope of the disclosure.

What is claimed is:

1. A miniature projection device, comprising:

a rotatable bracket assembly comprising a first rotatable bracket and a second rotatable bracket;

a rotatable plate;

a driving device configured to drive the rotatable bracket assembly in a first direction, and to drive the rotatable plate to rotate in a second direction, the first direction substantially perpendicular to the second direction; and

a light source unit mounted on the rotatable plate and capable of rotating together with the rotatable plate, the light source unit configured to emit laser beams and to project the laser beams onto a screen;

wherein the second rotatable bracket is rotatably received in the first rotatable bracket and rotatably coupled to the first rotatable bracket by two first sleeve shafts, and the rotatable plate is rotatably received in the second rotatable bracket and rotatably coupled to the second rotatable bracket by two second sleeve shafts.

2. The miniature projection device of claim **1**, wherein the second rotatable bracket is capable of rotating in the first rotatable bracket, along the first direction, and the rotatable plate is capable of rotating in the second rotatable bracket, along the second direction.

3. The miniature projection device of claim **2**, wherein the first rotatable bracket is substantially rectangular, the first rotatable bracket comprises two oppositely first facing inner side surfaces and two first rotation shafts, each first rotation shaft mounted to a corresponding first inner side surface, each first rotation shaft extends toward the second rotatable bracket, the second rotatable bracket comprises two first outer side surfaces, each first outer side surface faces a corresponding first inner side surface, each first sleeve shaft is mounted to a corresponding first outer side surface and extends toward and connects to a corresponding first inner side surface, each first sleeve shaft defines a first mounting hole receiving the corresponding first rotation shaft.

4. The miniature projection device of claim **3**, wherein the first rotatable bracket comprises two oppositely second facing inner side surfaces substantially perpendicular to the first inner side surfaces, the driving device comprises a plurality of first electrodes and a plurality of second electrodes, the first electrodes are mounted on the two second inner side surfaces, the second rotatable bracket comprises two second outer side surfaces, the two second outer side surfaces are substantially parallel to each other, each second outer side surface faces a corresponding second inner side surface, the second electrodes are mounted on the two second outer side surfaces, each second electrode is located between two neighboring first electrodes, and each first electrode is located between two neighboring second electrodes, first electrostatic forces generated by the first electrodes and the second electrodes drive the second rotatable bracket to rotate relative to the first rotatable bracket, along the first direction.

5. The miniature projection device of claim **3**, wherein the first rotatable bracket is formed by four first connection poles.

6. The miniature projection device of claim **3**, wherein the second rotatable bracket is formed by four second connection poles.

7. The miniature projection device of claim **2**, wherein the second rotatable bracket comprises two oppositely third facing inner side surfaces and two second rotation shafts, each second rotation shaft extends from the third inner side surfaces, the rotatable plate comprises two third outer side surfaces, each third outer side surface faces a corresponding third inner side surface, each second sleeve shaft is mounted to a corresponding third outer side surface and extends toward and connects to a corresponding third inner side surface, each second sleeve shaft defines a first mounting hole receiving the corresponding first rotation shaft.

8. The miniature projection device of claim **7**, wherein the second rotatable bracket comprises two oppositely fourth facing inner side surfaces substantially perpendicular to the third inner side surfaces, the driving device comprises a plurality of third electrodes and a plurality of fourth electrodes, the second electrodes are mounted on the two fourth inner side surfaces, the rotatable plate comprises two fourth outer side surfaces, the two fourth outer side surfaces are substantially parallel to each other, each fourth outer side surface faces a corresponding fourth inner side surface, the fourth electrodes are mounted on the two fourth outer side surfaces, each fourth electrode is located between two neighboring third electrodes, and each third electrode is located between two neighboring fourth electrodes, second electrostatic forces generated by the third electrodes and the fourth electrodes drive the rotatable plate to rotate relative to the second rotatable bracket, along the second direction.

9. A miniature projection device comprising:

a rotatable bracket assembly comprising a first rotatable bracket and a second rotatable bracket;

a rotatable plate;

a driving device configured to drive the rotatable bracket assembly in a first direction, and to drive the rotatable plate to rotate in a second direction, the first direction substantially perpendicular to the second direction; and

a light source unit mounted on the rotatable plate and capable of rotating together with the rotatable plate, the light source unit configured to emit laser beams and to project the laser beams onto a screen;

wherein the first rotatable bracket is substantially rectangular and comprises two oppositely first facing inner side surfaces and two first rotation shafts, each first rotation shaft mounted to a corresponding first inner side surface, each first rotation shaft extends toward the second rotatable bracket, the second rotatable bracket comprises two first outer side surfaces, each first outer side surface faces a corresponding first inner side surface, the second rotatable bracket comprises two first sleeve shafts, each first sleeve shaft is mounted to a corresponding first outer side surface and extends toward and connects to a corresponding first inner side surface, each first sleeve shaft defines a first mounting hole receiving the corresponding first rotation shaft.

10. The miniature projection device of claim **9**, wherein the first rotatable bracket comprises two oppositely second facing inner side surfaces substantially perpendicular to the first inner side surfaces, the driving device comprises a plurality of first electrodes and a plurality of second electrodes, the first electrodes are mounted on the two second inner side surfaces,

the second rotatable bracket comprises two second outer side surfaces, the two second outer side surfaces are substantially parallel to each other, each second outer side surface faces a corresponding second inner side surface, the second electrodes are mounted on the two second outer side surfaces, each second electrode is located between two neighboring first electrodes, and each first electrode is located between two neighboring second electrodes, first electrostatic forces generated by the first electrodes and the second electrodes drive the second rotatable bracket to rotate relative to the first rotatable bracket, along the first direction.

11. The miniature projection device of claim **10**, wherein the second rotatable bracket comprises two oppositely third facing inner side surfaces and two second rotation shafts, each second rotation shaft extends from the third inner side surfaces, the rotatable plate comprises two third outer side surfaces, each third outer side surface faces a corresponding third inner side surface, the rotatable plate comprises two second sleeve shafts, each second sleeve shaft is mounted to a corresponding third outer side surface and extends toward and connects to a corresponding third inner side surface, each second sleeve shaft defines a first mounting hole receiving the corresponding first rotation shaft.

12. The miniature projection device of claim **11**, wherein the second rotatable bracket comprises two oppositely fourth facing inner side surfaces substantially perpendicular to the third inner side surfaces, the driving device comprises a plurality of third electrodes and a plurality of fourth electrodes, the second electrodes are mounted on the two fourth inner side surfaces, the rotatable plate comprises two fourth outer side surfaces, the two fourth outer side surfaces are substantially parallel to each other, each fourth outer side surface faces a corresponding fourth inner side surface, the fourth electrodes are mounted on the two fourth outer side surfaces, each fourth electrode is located between two neighboring third electrodes, and each third electrode is located between two neighboring fourth electrodes, second electrostatic forces generated by the third electrodes and the fourth electrodes drive the rotatable plate to rotate relative to the second rotatable bracket, along the second direction.

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